Space Weather Technical Forecast

Issued on Friday, 21 April 2023 at 13:05 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1/Minor Storms due to CME activity, with a slight chance of G2/Moderate Storms on 20-21 April. Chance of M-class flares (R1-R2 Minor-Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low, with only minor C-class flares. There are currently seven regions on the visible disc. AR3282 remains the largest and most complex region on the disc, located in the northwest quadrant, but has been stable. A new region rotating onto the southeast limb is beginning to look more interesting, but is still too close to the limb to do a full analysis. The other regions appear to be mostly simple with some in slow decay.
A coronal re-alignment near AR3283 yesterday afternoon UTC may have given rise to a 'ghost' CME. This is currently being assessed for a possible Earth directed component.

Solar Wind / Geomagnetic Activity: The solar wind as observed by ACE at L1, showed waning weak CME effects. Wind speeds have been at ambient to slightly elevated levels, between 350-410 km/s. Density was average or below average. Total magnetic field strength was at moderate levels around 9 nT at first, then declined to become weak. The north-south component was moderately positive at first, becoming weakly variable. The phi angle was mostly negative (away from the Sun). Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) as measured at GOES16, was at background levels. High energy electron flux (greater than 2MeV) as measured at GOES16 was at background levels. The associated 24-hour electron fluence was well below the Active threshold on a steady trend, with 1.38e6 integrated pfu observed at 21/0000UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be generally Low, with a chance of isolated Moderate activity, mainly due to AR3282 but perhaps also from the new region rotating onto the southeast limb.

Solar Wind / Geomagnetic Activity: A CME may arrive at Earth sometime today, or even possibly tomorrow. Confidence in the arrival time and geomagnetic effects is low. Solar wind speeds are currently at background levels The next high speed stream from CH94 or CH95 (both negative) is likely to arrive on Days 2 or 3 (22-23 Apr), with wind speeds perhaps reaching 450-550 km/s.
Geomagnetic activity is forecast to be Quiet to Unsettled at first. Activity may increase with the potential CME arrival, becoming Unsettled to Active with a chance of G1/Minor Storms (Kp 5), and a slight chance of G2 Moderate Storm (Kp 6) intervals. Unsettled to Active activity with a slight chance of G1/Minor Storms may be prolonged through the following days with the anticipated HSS.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is most likely to persist at background levels, although there is a slight chance of S1 or greater, mainly

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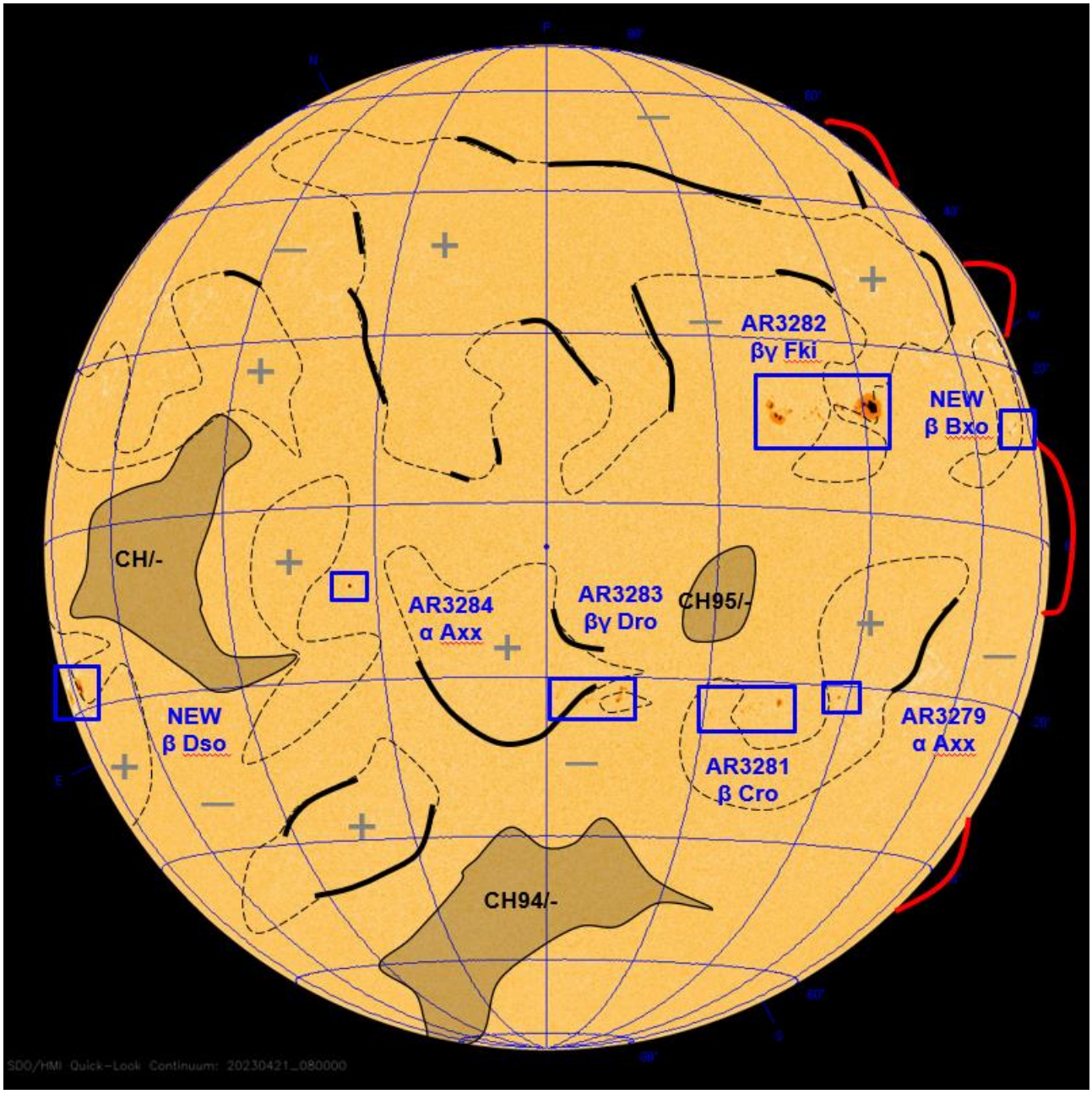
due to AR3282. High energy (greater than 2 MeV) electron flux is currently at background levels with little change expected throughout much of the period, although an increase is possible later in the period in response to HSS effects. The associated 24-hour integrated fluence is expected to remain below the Active threshold (1e8 integrated pfu), but with an increasing trend later in the period.

Figure 1. Solar Analysis Valid 21/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

A faint halo CME from a large filament eruption late on 15 April is likely to affect Earth, arriving sometime today, or even possibly tomorrow. Confidence in the arrival time and geomagnetic effects is low given the apparent diffuse signature of the CME in LASCO C2 and C3 imagery and limited STEREO A data for the event. Geomagnetic effects are expected to be limited as this is now a very slow CME.

Solar wind speeds are currently at background levels The next high speed stream from CH94 or CH95 (both negative) is expected to become geoeffective on Days 2 or 3 (22-23 Apr). CH94 is a high latitude feature so may not reach Earth, and is also smaller than on the previous rotation, and so any HSS will be slower to arrive compared to persistence. CH95 was more centrally located but has been obscured by sunspots to the south of it and is no longer visible. Wind speeds may reach 450-550 km/s.

Geomagnetic activity is forecast to be Quiet to Unsettled at first. Activity may increase with the potential CME arrival, becoming Unsettled to Active with a chance of G1/Minor Storms (Kp 5), and a slight chance of G2 Moderate Storm (Kp 6) intervals. Unsettled to Active activity with a slight chance of G1/Minor Storms may be prolonged through the following days with the anticipated HSS.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	40	30	20	5
Strong	G3	No	5	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/1343	Full	Filament eruption	NW	342 km/s	Possibly within next 12 hours	Low confidence in arrival time and impact

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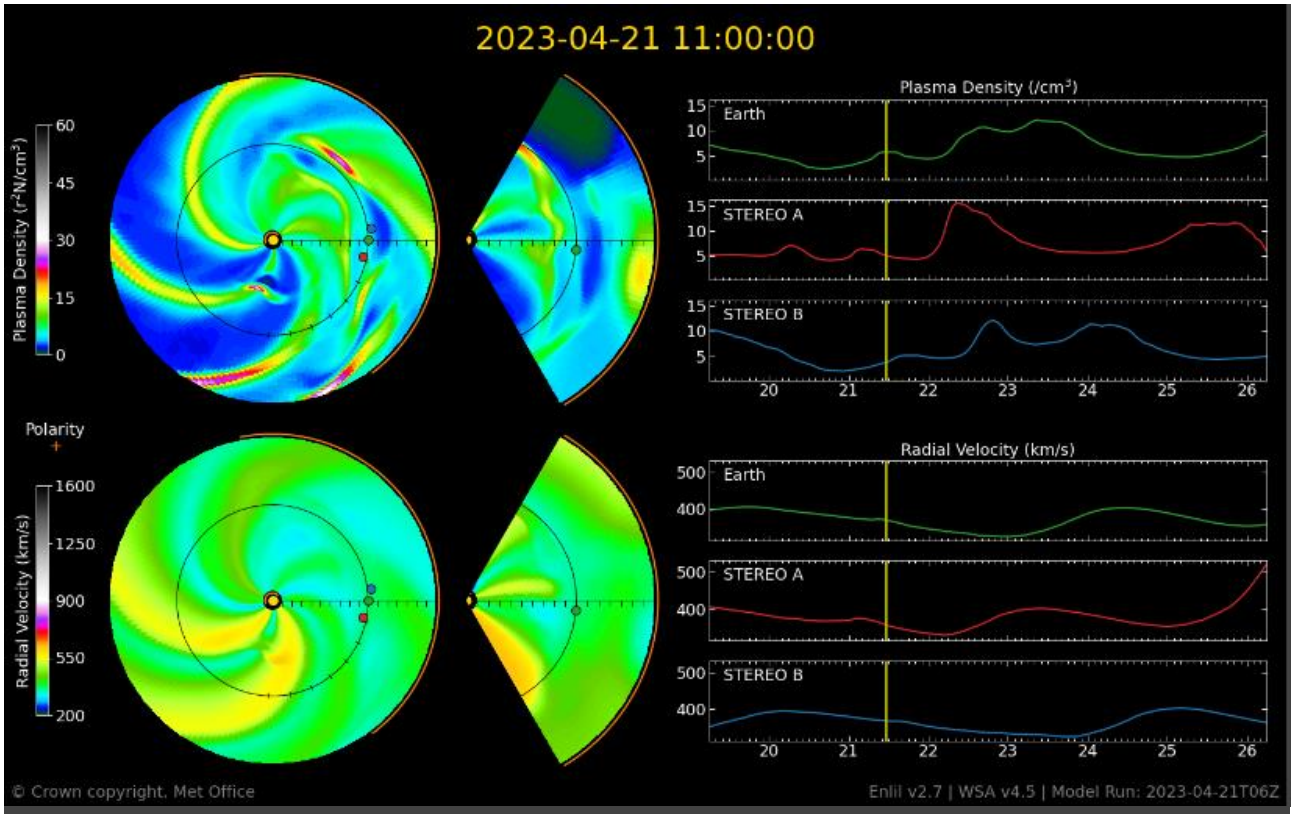
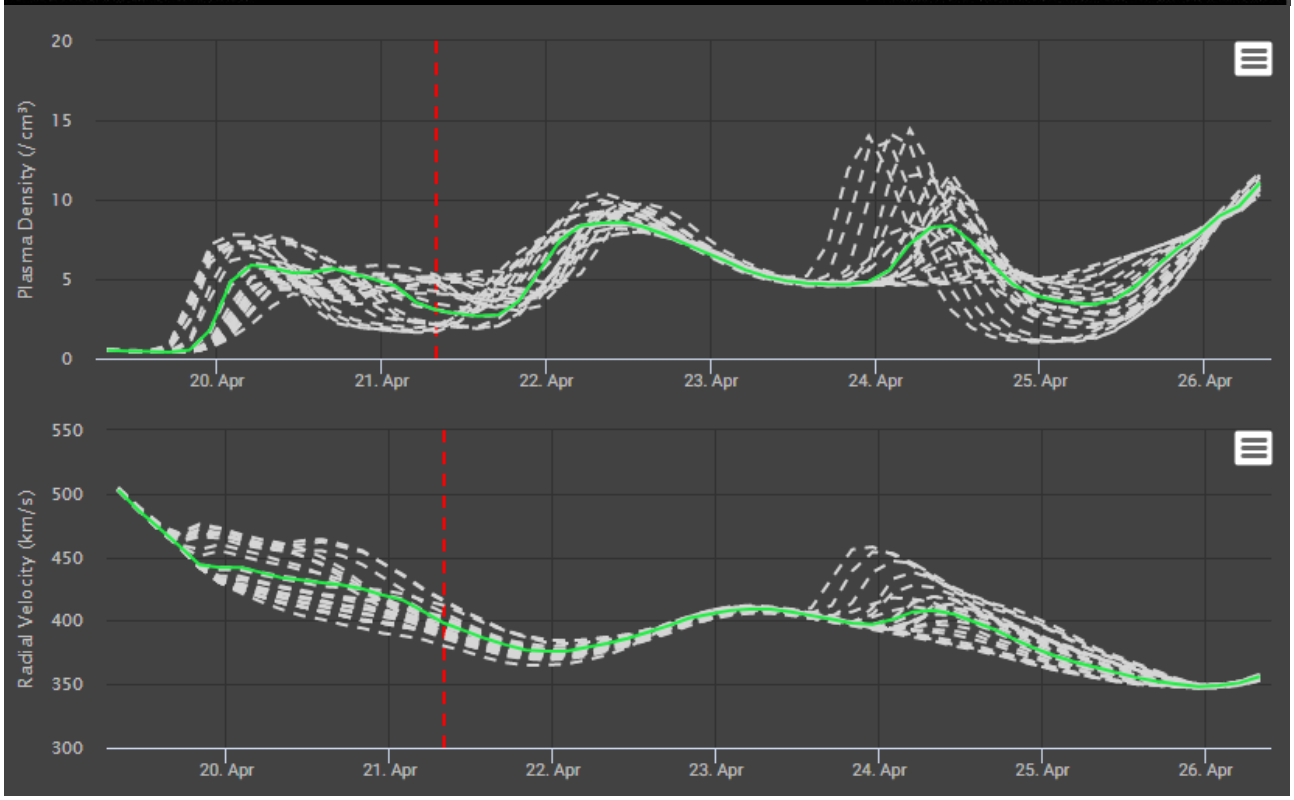
Figure 2: MOSWOC Enlil and ensemble showing spread of CME arrival times. Enlil is thought to be under-forecasting the high speed stream on 22-23 April.




Plasma Density (/cm³)
20. Apr 21. Apr 22. Apr 23. Apr 24. Apr 25. Apr 26. Apr
Radial Velocity (km/s)
20. Apr 21. Apr 22. Apr 23. Apr 24. Apr 25. Apr 26. Apr

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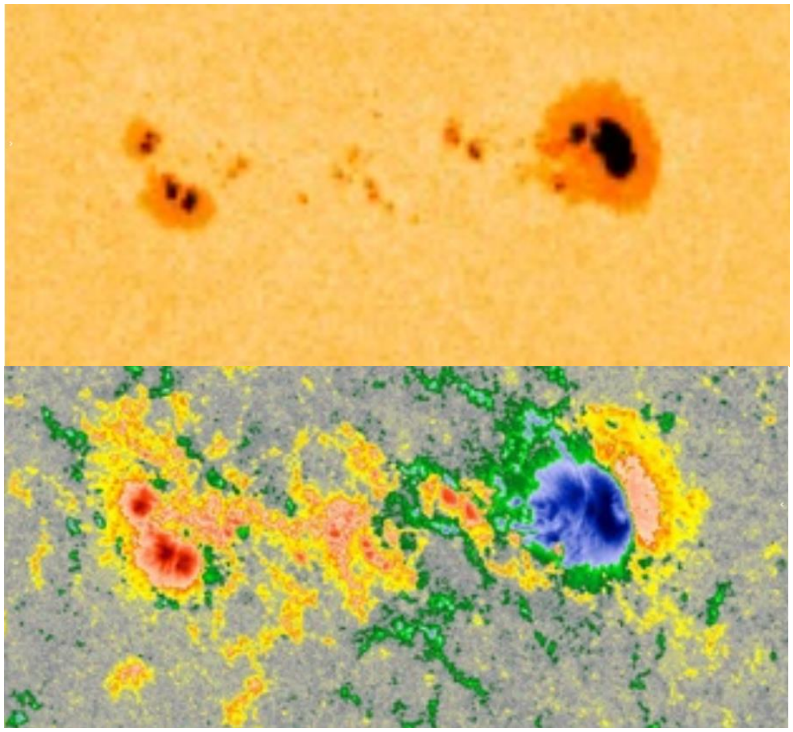
Radio Blackouts - X-Ray Flares:
There are currently seven sunspot regions on the visible disc. AR3282 (Fki/Beta-Gamma) remains the largest and most complex, located in the northwest quadrant. It has been largely stable, however. There is a new region rotating onto the southeast limb, which now has both leading and trailing spots with penumbra. It is still difficult to classify however, due to the viewing angle near the limb. AR3283 (Dro/Beta-Gamma) has been fading somewhat, but has also developed a weak Beta-Gamma magnetic configuration. A further new region has emerged near the northwest limb, showing some growth, but again is difficult to assess due to its proximity to the limb. The other regions appear relatively simple with some showing slow decay.

Solar activity is likely to remain Low. However, there is a chance of becoming Moderate with isolated M-flares. Any significant flares are most likely to originate from AR3282, but also perhaps from the new region rotating onto the southeast limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: AR3282, showing minor magnetic complexity in the intermediate spots, although this has faded a little in recent hours.



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Solar Radiation Storms - (High Energy Protons):
High energy proton flux (greater than 10MeV), as observed by GOES16, is currently at background levels. There is a slight chance of an increase to S1 or greater, should any larger flares occur, mainly from AR3282.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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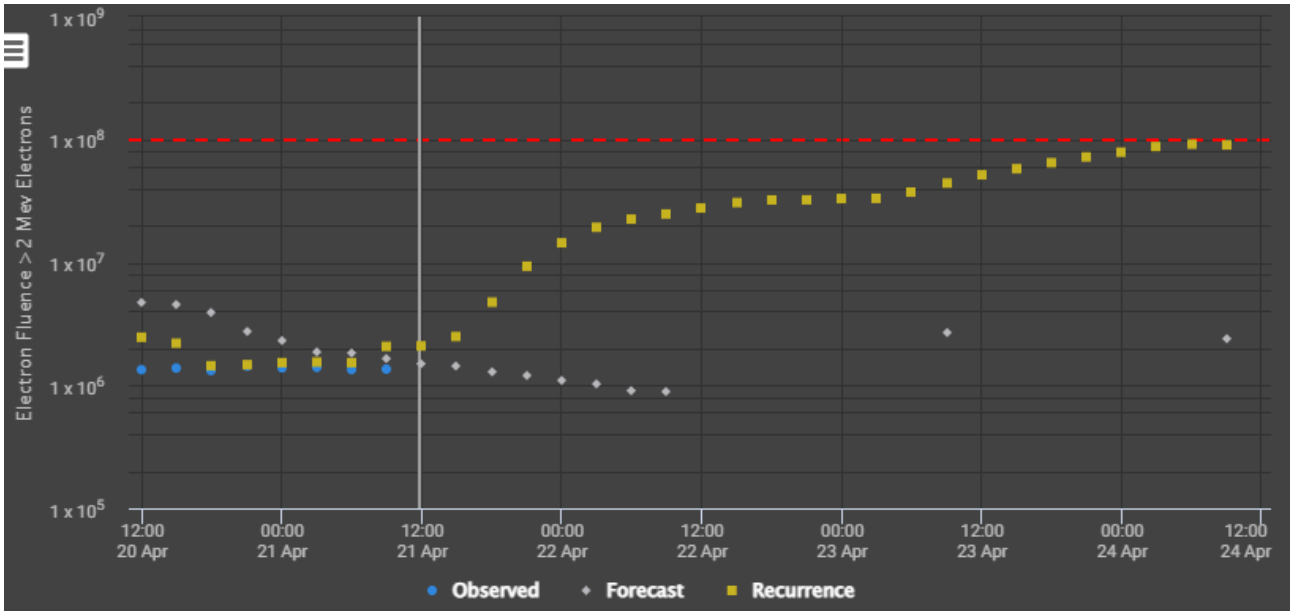
High Energy Electrons Event (≥ 2MeV):
High energy (greater than 2 MeV) electron flux is currently at background levels with little change expected throughout much of the period. However, an increase later in the period, perhaps reaching moderate or occasionally high levels at the diurnal peak, is possible in response to HSS effects.

The associated 24-hour integrated fluence is expected to remain below the Active threshold (1e8 integrated pfu), but with an increasing trend later in the period. MOSWOC REFM is forecasting a fairly steady trend through the next three days, which seems reasonable.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM showing a steady trend below Active (1e8 integrated pfu) over the next three days.



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